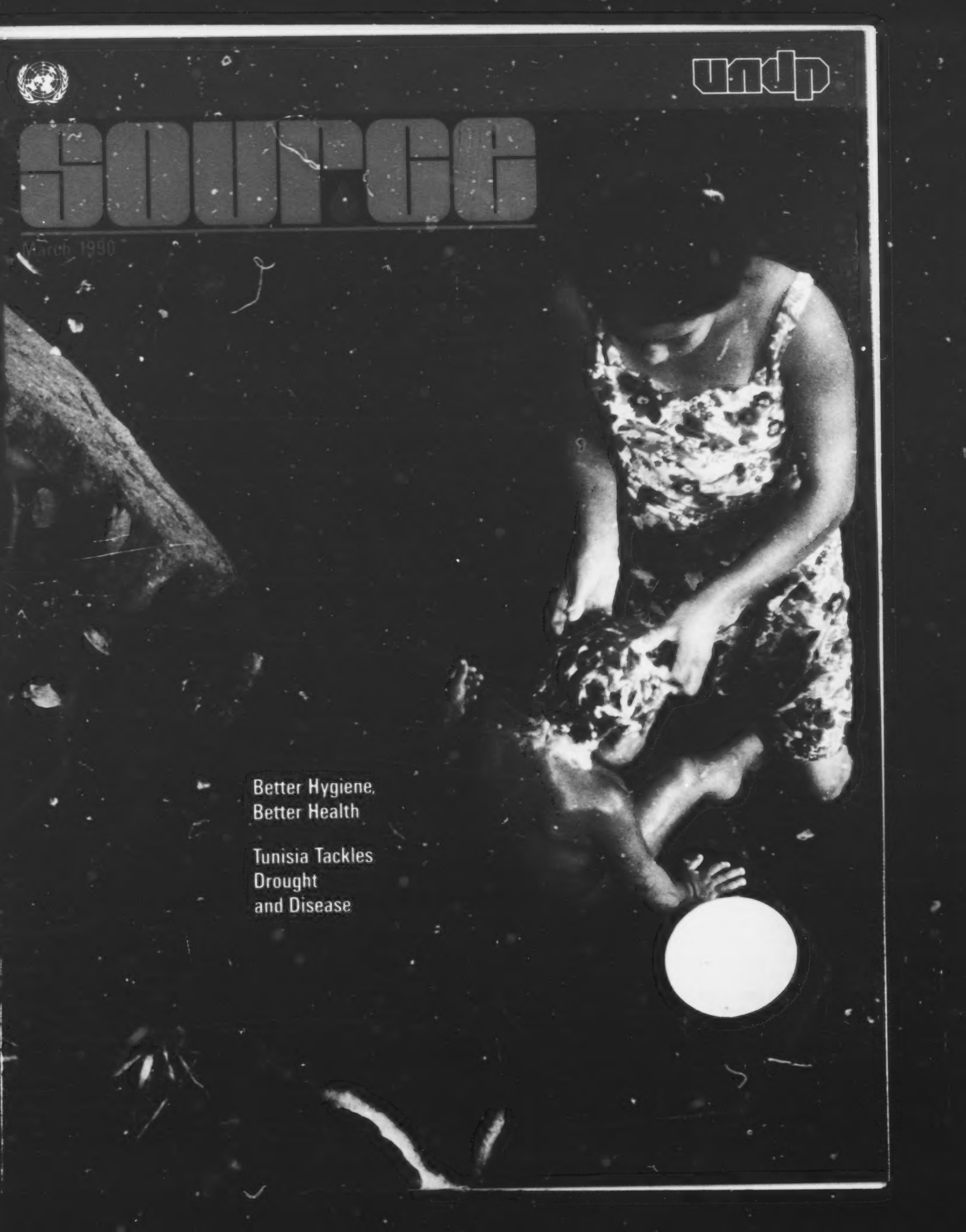
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March 1990
Better Hygiene,
Better Health
Tunisia Tackles
Drought
and Disease

Crisis on Tap: A World Running Short of Water

By Sandra Postel

Sandra Postel

Parakrama Bahu, the Great, 12th Century king of Sri Lanka, set the ultimate standard for water engineers: "Let not even a small quantity of water obtained by rain go to the sea without benefitting man."

But now the limits to Parakrama's vision are swiftly coming to light. Exhausted rivers, falling water tables and shrinking lakes testify to worldwide human abuse of water resources. Regional shortages are cropping up around the globe, and the threat will certainly spread if demand continues to escalate at current rates. Emerging scarcities will force hard choices and a shift in priorities.

The outcome of such choices will produce no winners until we begin to bring human wants and population size into line with the natural limits of water resources. Meanwhile, the question for many parts of the world is not if a crunch will come, but when.

"The next war in our region will be over the waters of the Nile, not politics," says Boutros Ghali, Egypt's minister of state for foreign affairs. Israel's Meir Ben Meir, a former head of the agriculture ministry agrees: "If the people of the region are not clever enough to discuss a mutual solution to the problem of water, war is unavoidable."

Nowhere are conflicts over water potentially more incendiary than in the arid Middle East, where three river basins form the backbone of water development efforts: the Jordan, the Tigris-Euphrates and the Nile. Usage has nearly reached the limit in two of the three, and contentiou political relations have thwarted efforts to reach water-sharing agreements. Yet the region has some of the highest population growth rates in the world and a climate that makes food production heavily dependent on irrigation. While Israeli farmers are among the most water-efficient in the world, in little more than a decade, the country's available supplies could fall 30 per cent short of demand.

Under the most optimistic assumptions — including nearly a ten per cent increase in water supplies from completion of a joint project with Sudan — Egypt appears headed for crisis. In a land where rain is scarce, 55 million people depend almost entirely on the waters of the Nile, none of which originate within the nation's boundaries. Its population leaps by one million every eight months, and with virtually no additional sources to tap, Egypt has no choice but to squeeze more out of its existing supplies by upgrading and better managing its irrigation systems.

China Daily reported last May that Beijing's two main reservoirs were diminishing rapidly. Water tables beneath the capital drop one to two metres per year, and a third of its wells have gone dry. India's 835 million people face severe shortages stemming as much from gross mismanagement of its land and water resources as from nature's fickleness. By the late 1970s, the government had invested more than US$12 billion in 1,554 large dams, but deforestation has now undercut much of that effort. Denuding of watersheds causes more water to run off in floods and less to percolate into the ground.

Common to these tales of shortage is the near-universal failure to value water properly in view of its scarcity. In the western United States, an imperfect but promising remedy is catching on: water markets. This practice involves the long-term transfer of water or water rights for an agreed-upon price. It can operate where

Continued on page 22

Sandra Postel is Vice President for Research at the Worldwatch Institute in Washington, D.C. This is an excerpt of an article published in Worldwatch magazine.

SOURCE

March 1990

Page 4: Tunisian school children learn about safe water.

Page 9: Rain water tanks in Western Samoa.

Cover: A Peruvian woman washes her child. UNDP photo by A. Holbrooke.

2 **LOOKING AHEAD** Crisis on Tap: A World Running Short of Water

4 **COUNTRY PROFILE** Tunisia Attempts to Beat Drought and Disease

9 **PACIFIC** Western Samoa Taps the Sky

12 **NORTH AMERICA** Echoes from America's Backyard

15 **TECHNOLOGY** India Battles the Perils of Fluoride

16 **TRAINING** Singapore Lends its Expertise to East Asia

18 **DONOR PROFILE** British Aid to Water and Sanitation: The Pursuit of Sustainability

21 **HEALTH** The Water, Dirt and Diarrhoea Debate

23 **IN PRINT**

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Director:
J. Russell Boner

Editor-in-Chief:
Lloyd Garrison

Executive Editor:
David Kinley

Editor:
Emma Robson

Design:
Esther Kurti, Director
Nieves Singian, Assistant
Maureen Lynch

Editorial Assistants:
Mila Feliciano
Jennifer Prince

Translations Manager:
Fauvette van der Schoot

Production:
Linda Inocencio-Groux
Annie Straw

Circulation:
Alison Walton
Danielle Strahl

Distribution:
Welde Hailemelekot
Aydin Atalay
Aubrey Trotman

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"Cleanse your garments and keep away from all pollution" — the Koran.

UNDP photo by Emma Robson

Health worker Amel Soltane surrounded by school children in Aïn Zina.

Tunisia Attempts to Beat Drought and Disease

By Emma Robson

Tunisian efforts are currently focused on providing safe water supplies to the almost 50 per cent of the rural population that remains unserved.

READEX FICHE

Proposed pilot project area.

Ain Zina, Tunisia — Scores of school children pour out of their classrooms at mid-day and flock around a familiar lady with a smiling face and a clean white veil. They are eager to show off their new knowledge to their old teacher. But Amel Soltane has not made the 40-kilometre trip from the regional capital of Kairouan to test spelling or arithmetic.

"Do your families use chlorine in their water?" shouts Mrs. Soltane. "Yes! three drops a litre," chant the children.

"Do you remember to wash your hands?" asks the government health trainer. "Yes. Before every meal," the children reply.

Over the centuries, Tunisian muslims have been made aware of the need to keep themselves and their homes clean by the Koran. Recently, Tunisia's Ministry of Health has taken a leaf out of the sacred book by including health and hygiene training in its national activities. For the last two years, the Ministry's regional office in Kairouan, under Mrs. Soltane's guidance, has made community health education a prerequisite to new water supply projects. The results show.

Mrs. Soltane recalls earlier visits to this cluster of 200 families near the town of Haffouz when the people had to walk four kilometres to a well for water of dubious quality. "The children get sick much less now and they look healthy," says Mrs. Soltane. "Look, their hands, faces and clothes are spotless."

Water scarcity has long been a problem in Tunisia, especially in the arid south. Recent droughts have dried up many small reservoirs and lowered groundwater levels nationally to the point that many wells have been abandoned. Following a sharp increase in the incidence of waterborne diseases in 1984, new efforts have focused on improving water quality. Many existing wells contain dangerous levels of salts, and germs causing diseases such as viral hepatitis, typhoid and other strains of diarrhoea. The Ministry of Health attributes the presence of these and other diseases to a lack of sanitation in rural areas, and the siting of latrines and septic tanks above or at the same level as the water table.

Tunisia still has a long way to go in its development of adequate sanitary disposal. Currently, only 20 per cent of the rural population has efficient facilities, but since the rural population is dispersed, the Ministry of Health considers safe water a more pressing need than promotion of sanitation.

Since Tunisia's safe water supplies are too deep for simple well-digging, communities are dependent on outside assistance. Several donor organizations have helped Tunisia to improve rural water facilities, mostly by rehabilitating village wells. "But despite all this help, our rural water systems were failing because of lack of maintenance and health training," says Slaheddine Cheniti, acting director of the Ministry of Health's Office for Hygiene and Environmental Protection.

"The people continued to use their polluted sources because they did not understand the hazards," says Mohamed Jaoua, director of the Ministry of Agriculture's engineering department, charged with supplying the dispersed rural population.

But since mid-decade, the pace of improvements in facilities and people's health has accelerated greatly, thanks to a new emphasis on health education and much better organization at the village level.

"Five years ago, only 15 per cent of the population in Kairouan had good quality water," says Dr. Abdel Latif Bouden, the Ministry of Health's regional director. "Now more than 50 per cent have a safe supply." The combination of new water supply facilities and health training in Kairouan has cut the incidence of viral hepatitis by 50 per cent in five

UNDP photo by Emma Robson

Women drawing clean water from the village tap, which is fed by gravity from a storage tank.

years to less than one case in 1,000 people. Diarrhoea has been reduced by 80 per cent.

Mrs. Soltane's education programme took off two years ago when l'Organisation Canadienne pour la Solidarité du Développement, a Québec based non-governmental organization, helped her prepare training videos and slide shows. "We still need to improve our methods and equipment, but the Canadians helped point us in the right direction," says Mrs. Soltane.

Besides health education, Mrs. Soltane and government officials view the establishment of village water committees nationwide as a major achievement. A law passed in 1987 obliges rural communities to form users committees called Associations d'Intérêt Collectif. Since enactment, more than 200 committees have sprung up across the country with the help of Ministry of Agriculture workers. Monthly fees from local residents support a full-time caretaker to keep the area surrounding the water source clean, and pay a plumber to do repairs and settle the electricity or diesel fuel bills in the case of mechanized pumps. "The lack of an institution through which to work at the community level was the main obstacle to progress," says Ameur Horchani, Secretary of State for Water Resources at the Ministry of Agriculture.

While a further 1.5 million rural Tunisians have yet to be provided with safe water, recent improvements in the country's approach place it in a better position to achieve full coverage in the next decade. As more families gain easier access to safe water, the importance of the hygienic disposal of excreta and domestic wastewater will come to the fore. "We're really behind on sanitation," says Mrs. Soltane, "but hopefully, with more education families will realize the importance of latrines and will build their own." ■

A Problem of Technology

Tunisia's safest water is deep — often more than 60 metres below the surface. No existing handpump can draw water from such depths. Less than one third of rural areas have electricity, ruling out the use of electric pumps. "There is no one technological solution for the whole country," says Adel Guéttat, sanitary engineer attached to the Ministry of Health.

While the country is experimenting with a variety of technological solutions, including solar and wind pumps, it relies on electric and diesel-fueled pumps in most areas. These mechanical pump systems, complete with a storage tank and distribution pipes, cost an average of US$100,000. The price varies according to the distance the water has to be transported, which in some regions can be more than ten kilometres. While expensive, these high-power pumps place Tunisia in a better position to deal with population growth. And as demands for better rural living standards increase, more powerful pumps can be easily installed in the deep boreholes to provide for individual household connections. ■

UN photos by John Isaac

Factory pollution poses a threat to Tunisia's coastal towns and its important tourist industry.

The Ministry of Agriculture is using purified wastewater to irrigate crops near the capital.

Better Urban Environments

Since the creation of the National Sanitation Office (ONAS) in 1974, Tunisia has made great strides in handling urban household waste. Expansion of household water connections in Tunisia's towns and cities, however, necessitate further investments in sanitary facilities to keep pace with water supply. A recent World Bank survey of the Tunisian environment reported that many urban areas still lack facilities for the safe disposal of household and industrial waste.

"All major cities now have adequate sewage disposal systems," says Mohamed Larbi Khrouf, who heads the Department of Development at ONAS. Thanks to its efficient management, ONAS has mobilized external financing from the World Bank, the Islamic Development Bank, the Saudi Arabian Development Bank, the West German development bank KfW, the European Community and the Swedish and US development agencies.

External loans have helped ONAS double its budget over the last ten years to $30 million in 1990. But that budget would have to rise a lot more for ONAS to be able to serve the entire urban population with the costly, traditional sanitation technologies it uses. An estimated 2.5 million people in smaller cities and peripheral urban areas still depend on systems that are less than adequate.

Recognizing the need for low-cost alternatives, the Ministry of Equipment and Housing asked the United States Agency for International Development (USAID) to investigate affordable technologies that could be promoted by the private sector. USAID's Water and Sanitation for Health (WASH) is now helping the government develop a national strategy for sewage disposal for areas not covered by ONAS. One proposal calls for the use of giant septic tank systems serving clusters of houses.

Despite the gaps in ONAS's coverage, the organization can point to great improvements in the country's wastewater disposal and treatment facilities. "Before 1975 there was only one wastewater treatment plant in Tunis," says Mr. Khrouf. "Now Tunis has five plants which work very well, and there are 21 others throughout the country." Treatment of wastewater, besides being an essential environmental precaution, is of particular importance to Tunisia. With limited fresh water resources and growing water demands for agricultural and industrial use, Tunisian officials realize that the future depends on recycling. ONAS plans to construct

Getting its House in Order

UNDP photo by Emma Robson

Rural Tunisians walk long distances for water.

20 new wastewater treatment plants over the next five years. The Ministry of Agriculture plans simultaneously to expand use of treated wastewater for agriculture. It is currently using 15,000 cubic metres of the 133,000 of wastewater purified daily in Tunis to irrigate a 1,000-hectare pilot plot of fruit trees.

The new National Agency for the Protection of the Environment is charged with issuing guidelines for industrial users, whose largely untreated effluent is becoming a serious problem. Tunisia's large phosphates industry, concentrated on the Eastern coast, poses a major threat to the water supply of coastal towns and the Mediterranean. A host of smaller inland industries are also contributing to a general deterioration of Tunisia's groundwater. A new decree passed in 1989 set limits on substances permissible in waste effluent.

The next step is enforcement. "We are currently running a campaign aimed at encouraging factories to pretreat their water," says Mr. Khrouf. "Some do already, many others do not." Due to financial constraints, many Tunisian factories, even with tax breaks, are unable to install the costly purification equipment required for the removal of heavy metals. "Our industries are fragile. They need subsidies and technical assistance," says Mr. Khrouf. ■

Tunisia's prospects for improving water and sanitation facilities looked grim at the launch of the "Water Decade" in 1981. Responsibility for the sector lay with 20 different government departments which had little experience of working with each other. Lack of co-ordination resulted in a low level of government investments, especially in rural water supply. It also hampered foreign development assistance.

Prior to 1980, rural water supply was considered less important than the execution of major water supply projects in urban areas, where just over half the population of eight million lives. But recognizing the low rural coverage as a major problem, the government raised the national budget for rural water supply to $115 million a year in the six-year development plan beginning in 1980, from $26 million in the previous plan. "As it turned out, just over half that budget was used because the departments were disorganized," says Slaheddine Cheniti, acting director of the Ministry of Health's Office of Hygiene and Environmental Protection.

With the launch of the UN "Water Decade," further attention was focused on serving rural areas, less than one third of which had access to a quality supply within a reasonable walking distance. In 1984, the Tunisian government began drawing up a masterplan for rural water supply and sanitation with assistance from the United Nations Development Programme (UNDP). The World Health Organization-executed project promoted closer cooperation between officials of the various agencies responsible for water supply. "The project certainly improved co-ordination," says Mr. Cheniti. The WHO team organized seminars on appropriate technologies and water quality analysis. It also stimulated the interest of donors in launching new projects.

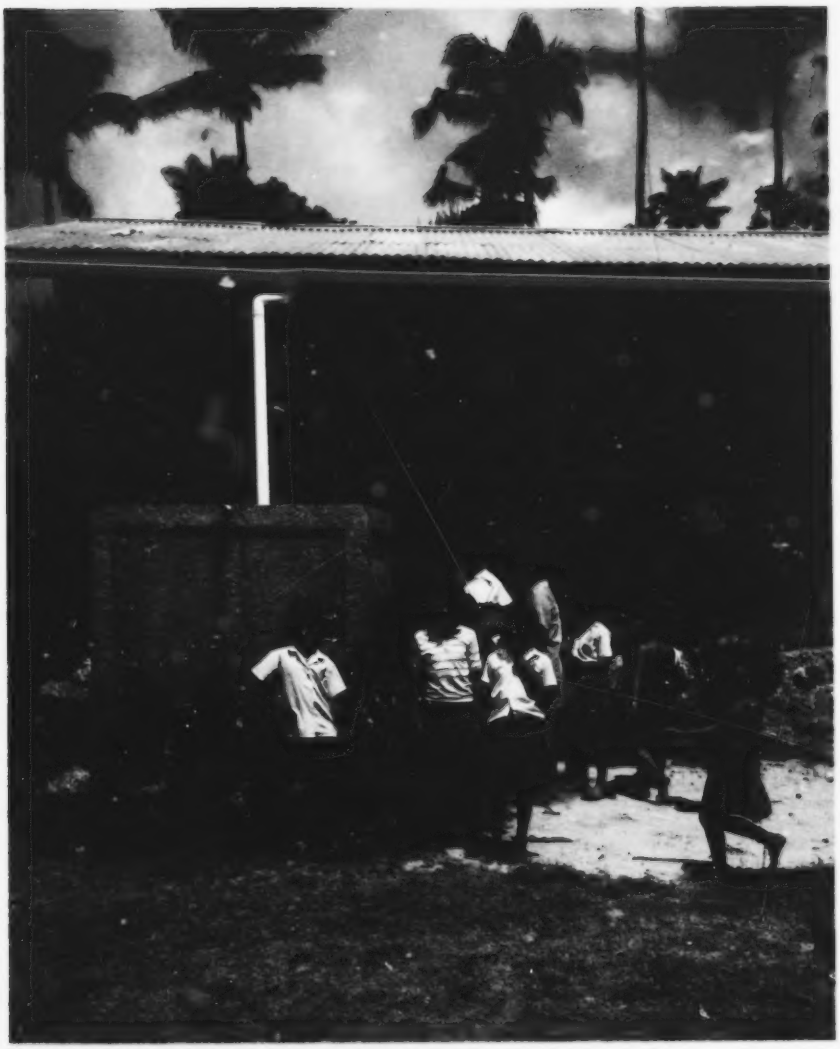
Tunisia is currently seeking financing for a pilot project in the governorate of Gabès, one of two regions identified as being most in need. Gabès has both a high incidence of waterborne diseases and high salinity in its abundant surface water supplies.

Technologies new to Tunisia — windpumps, ventilated improved pit latrines and low-cost ways of filtering germs and removing salt from surface water — will be tested and will give the water and sanitation authorities a major opportunity to forge a closer relationship. ■

Western Samoa Taps the Sky

By Cherie Hart

UNDP photo by Cherie Hart



The Faleu Primary School has new rainfed tanks.

Apia, Western Samoa — Desperate for water, local citizens on the Western Samoan island of Manono regularly cracked open the community school's water tank to tap its precious contents. But now the Faleu Primary School has seven rainfed tanks which it shares willingly with local residents during dry spells. The construction of 62 other tanks on the tiny island has relieved the water shortage which had plagued the 900 residents for years.

"The tanks have made a big difference in our lives," says Fa'alupega Leiataua, who lives on Manono. "I used to depend on the big communal tank we had near the church, but that always ran low." Sometimes she could also get piped water from Apia, Samoa's capital city, 40 kilometres away on the island of Upolu. But that water was severely rationed. Her next alternative was to travel a half hour by dinghy with empty buckets to the nearest water pump on the island of Upolu. Now, all she has to do is walk outside her home.

The new water tanks are part of a national initiative that began in 1981 to bring safe water to areas inadequately served by piped water supplies. While 95 per cent of the 165,000 Samoans have access to piped water, only 30 per cent of those people benefit from it year-round. This is due in part to insufficient

water from the wells during the May through October dry season. Some villages located at the end of a pump system never receive any water at all. Pumps habitually suffer from breakdowns. Western Savai'i has no rivers and must depend on bore-holes and pumps. But those sources are often infiltrated with salty seawater.

Technicians in Samoa decided that rainwater tanks could provide a valuable source of salt-free water and serve as an important supplement to piped supplies. The annual rainfall in Apia averages 290 centimetres. But at least half the roofs available for rainwater catchment had no tanks. The Government of Western Samoa, therefore, requested assistance from the UN Capital Development Fund (UNCDF) to provide 600 storage tanks to 23 villages in Savai'i.

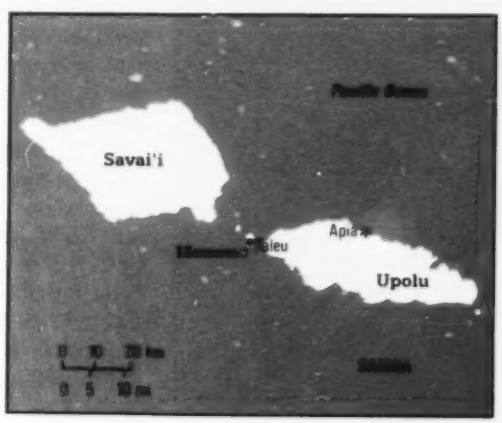
A special grant for this purpose was made available to UNCDF through AGFUND in 1982. Heavy demand in 1985 forced the target number of tanks to be increased to 3,000 with a capacity of 4,500 litres each.

Carried out by the United Nations Development Programme (UNDP) and Samoa's Department of Public Works, the US$1.5 million effort was successfully completed in 1988. More than 30,000 villagers on the islands of Savai'i, Upolu and Manono benefitted from the 3,000 new tanks. It was such a success that in 1989, the government requested additional funds for 1,000 more tanks. "This is one of the most useful aid projects that has ever come to Samoa," says Isikuki Punivalu, Director of Public Works for Western Samoa.

Still, the project faced difficulties along the way. Government officials and project engineers disagreed on design choice — round versus square tanks. "We are aware of why a coconut is round — it's strong," says Jack Netzler, Minister of Public Works. "We were wary at first about the idea of getting square tanks."

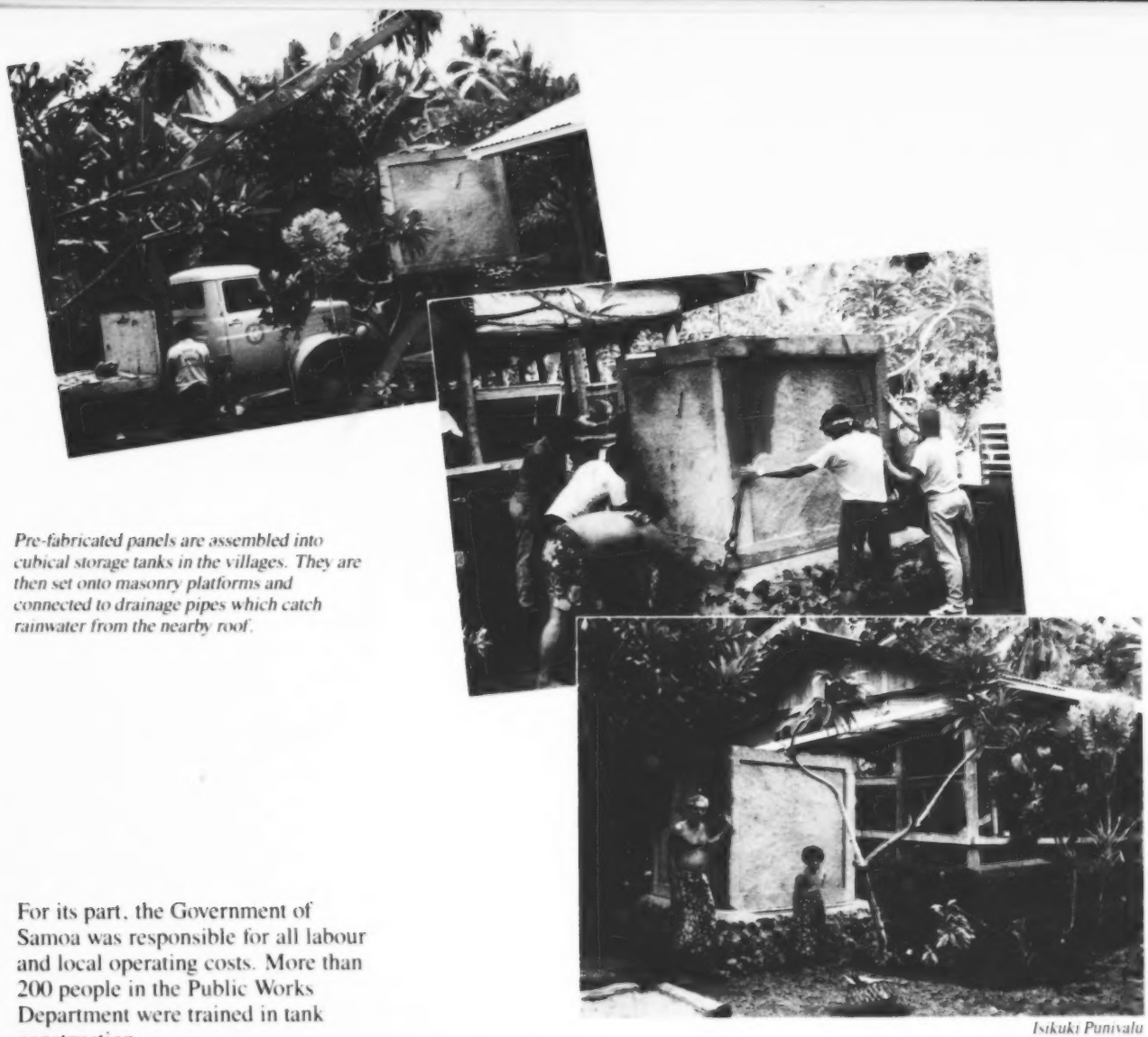
But it was soon discovered that traditional cylindrical ferro-cement tanks cannot be transported easily to remote sites after completion. Their construction also requires more skill than is needed for building prefabricated square panels. A reinforced concrete design, called a High Tensile Wire Reinforced Fibre Ferrocement tank, was ultimately chosen for the project. These tanks consist of thin-wall reinforced concrete panels that are assembled in the villages into individual cubical storage units, built on masonry platforms.

A water tank panel pre-casting plant and two tank assembly yards were set up near the capital. UNCDF provided wire, steel fibre, cement, pipes, molds and hand tools for fabrication of the panels. It also supplied a crane, trucks and a forklift for the panels to be transported to construction sites. UNDP provided the project engineer who designed, tested and supervised delivery of the tanks.



UNDP photos by Cherie Hart

Right: Rusty metal drums are being replaced with cement containers.



Pre-fabricated panels are assembled into cubical storage tanks in the villages. They are then set onto masonry platforms and connected to drainage pipes which catch rainwater from the nearby roof.

Isikuki Punivalu

For its part, the Government of Samoa was responsible for all labour and local operating costs. More than 200 people in the Public Works Department were trained in tank construction.

While the design proved to be transportable and easy to install, a few of the early ones leaked at the lower corners. The project engineer, Steven Iddings, immediately tackled the problem with low-cost remedies. He modified the construction by increasing the thickness of the panels from 16 millimetres to 19 millimetres. Each tank was also coated on the inside with a chlorinated rubber sealant before delivery.

The solution worked, but the project faced another obstacle. Despite radio announcements and posters advertising the tanks, distribution of the first tanks was slow. Stacks of panels, which had been shipped by boat from Upolu to Savai'i, sat untouched for four months. "No one wanted to pay the $160 that the government was asking for the tanks," says Mr. Punivalu. "We felt that people should pay something, because then they would value the tanks more and take care of them."

The price eventually came down to $80 and demand increased. When they were all sold, income earned by the Samoan government from the sale of tanks reached $240,000, or nearly half of its financial contribution to the project.

But no price tag can be placed on the benefits these tanks have brought to the people of Samoa. "Many villages got rid of the rusty metal drums they used in the past for catching rain," says Ram Batra, Deputy Resident Representative of UNDP in Western Samoa. "Safe water is regularly available with these new tanks. It's free and no meter is running on it." ■

Echoes from America's Backyard

By Deepa Narayan-Parker

Rush Creek, Virginia — It is a beautiful crisp autumn morning and a dozen people are waiting outside a country store nestled in a valley amid forested mountains. When the visitors arrive, five women huddle shyly away from the men and strangers, and begin talking in low musical voices.

"I haul water every day from a spring which dries up in the summer. Then I fetch water from the creek," says 37 year old Patsy Thomas. "I use an outhouse, and every winter I dream about having an indoor toilet."

The complaints were familiar. I had heard them many times in villages across Asia and Africa. The setting was unexpected: Rush Creek, Virginia, one hour west by air from Washington, D.C. Indeed, it was with skepticism that I joined a group of experts from the United Nations Development Programme (UNDP) and the World Bank going to western Virginia seeking answers for their work in developing countries. The

Many rural Virginians, like this woman in Plum Creek, must go outdoors to pump water.

Virginia Water Project

Rush Creek is in the Appalachian Region of the US.

group had come to learn from the experiences of the Virginia Water Project (VWP) in Roanoke Valley.

While I had seen the poverty problems of America's cities, I was unaware of the need for Community Action Agencies which work to bring safe water and sanitation to rural people's homes in the U.S.

Since 1969, the Virginia Water Project has helped provide drinking water and sanitation for the first time to 20,000 Virginian families in over 200 remote communities. To reach the 200,000 still unserved people in Virginia, the project has expanded across the state. It is also now operating in the Carolinas, Georgia, Florida, Delaware and Maryland.

Hearing about the experiences of poor Virginians, especially the women, and about the evolution and growth of the water programme, I was struck by the parallels to my own developing country experiences.

"I could never have predicted that I would become an activist in battles against poverty," says 63-year-old Wilma Warren, the fiery founder and Executive Director of the VWP. "I was just a southern mother raising four children when I was forced to look for a job. In 1965, I found myself at TAP as a secretary." TAP — Total Action Against Poverty — is one of the thousands of Community Action Agencies which grew out of President Lyndon Johnson's war on poverty.

"Back then we didn't know what we were doing, but we started on the assumption that the poor knew their needs best," says Ms. Warren. "We went to the communities and asked people what they needed. We were very surprised to hear about lack of drinking water and toilets."

Such survey work helped spark the creation of VWP as an independent Community Action Agency. It also helped VWP organizers realize that the basic problems were not technological, but organizational and financial.

From the very beginning, the VWP emphasized building up local capacity and leadership. The programme philosophy centred around enabling people to solve their own problems. However, the strategies used have evolved considerably over a period of 20 years.

"In the early days, our goal was to create water systems that were completely controlled by communities who would participate in design, finance, operation and maintenance of the systems," says Mary Terry, VWP's administrative director.

Outreach workers began by doing a house-to-house survey and mapping existing water and sanitation facilities. This was followed by an income survey to determine the number of households that fell below the poverty line and hence qualified for federal assistance. The VWP then provided a small grant to hire a private contractor for an engineering design, after which federal grants were sought.

To increase a sense of ownership, a private community-owned stock company was created in which every community member had to buy a one dollar stock. Detailed by-laws, rules and regulations were worked out to make the companies independent legal entities. Once the water systems were completed, all the operation,

Virginia Water Project

The Virginia Water Project is helping replace outside latrines with indoor toilets linked to septic tanks.

David O. Garcia

Wilma Warren, Executive Director of VWP.

maintenance and financial management was done by community volunteers.

But problems emerged after the first few years. "Although initially willing and excited, community volunteers started feeling burdened and requested salaries," recounts Mary Terry of VWP. The combination of rising electricity costs, more stringent water quality regulations and increasing salaries soon put management of many of the water systems beyond the financial capacity of the communities. "The companies were dissolved and communities urged local authorities to take over the ownership of the water systems," says Ms. Terry. The role the communities assigned to themselves was payment of a monthly bill.

Today, VWP no longer aims for total community control. Rather, the goal is to establish a partnership between communities, local authorities and the private sector.

Successful Community Action Agencies always experience pressure to expand. However in expanding, agencies become increasingly bureaucratic and often lose their ability to respond to local needs. The VWP is avoiding this problem in an innovative way.

"The concept of networking is a key element in our successful expansion," says Wilma Warren. Rather than expand its own organization everywhere, VWP works through 28 independent community agencies and serves as an advisory resource to them.

One example is VWP assistance to the work of People Incorporated in communities lacking safe water around Hayters Gap in Washington County, Virginia. People Inc. brought information and technical know-how to the communities using volunteers from VISTA (Volunteers in Service to America). They taught community members how to organize, raise funds, weigh technological options and legislation, and then provided a small grant for a water system design. The rest was up to the local people.

In one such community, fed up with broken promises, 46-year-old Laura Broadwine found herself emerging as a leader, organizing to pressure the local county board to give Tumbling Creek the promised grants for piped water supply. "I was so angry I got involved out of sheer indignation," says Ms. Broadwine. A boycott of the nearest business community finally forced the county supervisors to take the "hillbillies of Tumbling Creek" seriously. Energized by its success, the community is now raising resources to bring water to their school.

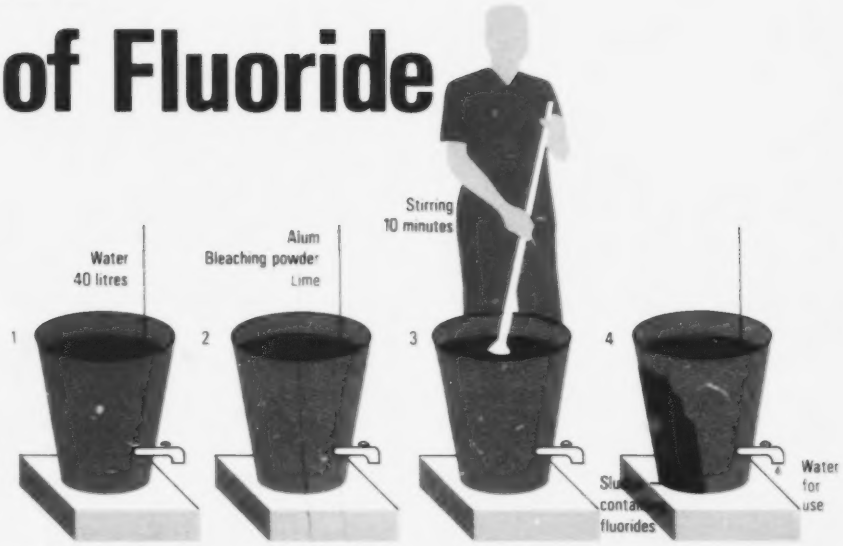
Overcoming traditional attitudes in remote communities is not easy, however. "My biggest problem is a simple one," says Monica Woodward, who has spent the last two years as a VISTA outreach worker. "I am a southern woman and men don't take me seriously when I solicit bids for engineering designs for water systems."

As I flew back over the mountains of Virginia, I wondered if Monica Woodward would be surprised to know that she had much in common with women from the mountains of Nepal to the sandy desert of Botswana. I wondered again at the suitability of words like "developed" and "developing" that sometimes create such harmful, divisive mind-sets.

In the search for culture-specific solutions, I realized, development workers spend so much time focusing on the differences that we sometimes overlook the essential unity of humankind and the sameness of the environment of poverty everywhere. ■

Deepa Narayan-Parker, an Indian developmental psychologist, works with UNDP's "Promotion of Women in Water and Environmental Sanitation Services" (PROWWESS) Project.

India Battles the Perils of Fluoride



Defluoridation

The water supplies of 25 million Indians and 40 million Chinese contain dangerously high levels of fluorides. But Indian experts have recently developed a purification method which they say is so simple it can be practiced at village level by uneducated people. In small amounts, fluoride has been shown to prevent tooth decay, which is why many countries add it to water supplies and toothpaste. In excess, however, it can cause mottled teeth, blue skin and fluorosis, a disease which in its most chronic form makes existing bones soft and crumbly and causes new bone formations to protrude in abnormal places.

Fluorides originate from minerals in the earth's crust. In most groundwater supplies they are insoluble. But under certain geological conditions — particularly in parts of China, India and the Arabian Peninsula — they dissolve and seep into the water supplies in excessive amounts. The World Health Organization recommends between 0.6 and 1.7 milligrammes of fluoride per litre of water for prevention of tooth decay. Chronic fluorosis is caused by an estimated daily intake of 15-20 milligrams per litre over several years.

The potential health dangers of excessive fluorides in water were identified in the late 1920s. Since then, many methods have been developed for their removal. Most of the methods are costly and complicated. The Indian process, by contrast, costs about two rupees (US$0.20) per cubic metre of water, depending on the quantity of chemicals necessary.

The method is an adaptation of the existing alum coagulation technique and was developed by India's National Environmental Engineering Research Institute. The process, called the Nalgonda Technique, involves the addition to water of bleaching powder, sodium aluminate or lime, and aluminum sulphate or aluminum chloride. After these chemicals are added, the water is flocculated, a process whereby particles are made to stick together in clusters by adding alum. The clusters are then allowed to settle and the water is drawn off.

Domestic treatment for removal of excess flouride from water can be carried out in a bucket, with a tap three to five centimetres above the bottom of the container. Chemicals are added to the raw water in recommended quantities, then comes an alum solution, followed by a ten-minute stir. The water is left to settle for one hour, is drawn through the tap, and the sludge containing the fluorides must be responsibly discarded.

The National Environmental Engineering Research Institute has also developed guidelines for a larger-scale method, to serve populations of up to 200. The Government of India's Water Technology Mission programme has commissioned more than 100 of these larger defluoridation plants in various parts of the country afflicted with excess fluoride problems. ■

Singapore Lends its Expertise to East Asia

By Emma Robson

Singapore — Singapore is one of the smallest and most densely populated countries in the world with scarce water resources. Given its physical constraints, the island's accomplishments in water and environmental management serve as outstanding examples, even to many industrialized countries.

Thanks to system-wide maintenance and a profusion of water-saving devices (with each push of the button in the bathrooms of Singapore restaurants you have less than five seconds to rinse your hands), Singapore's per capita water consumption of 112 cubic metres a year is about one-twentieth that of the United States.

Small wonder, then, that after a recent search for an East Asian capital to serve as its new regional headquarters, the United Nations Development Programme (UNDP) and World Bank's Water and Sanitation Programme selected Singapore. "I was looking for a country which could share its achievements with surrounding countries," says the Bank's Saul Arlosoroff, who left his Washington D.C. post as programme manager to head up the Regional Water and Sanitation Group (RWSG) for East Asia and the Pacific.

Due to rigid water quality control, every tap in this small island nation issues clean, safe water around the clock. In every litter-free shopping mall stands a clean latrine with automatic water taps. Restaurants, from the deluxe down to ethnic food sold by former street vendors now located in "food centres," are subject to rigid hygiene controls.

"There is very little we can contribute to Singapore," says Mr. Arlosoroff, who plans to start four international training courses during the period 1990-1991 in collaboration with the Singapore water and environment authorities.

Approximately 1.5 billion people live in the East Asia and Pacific region, the most densely populated region of the world. The area's urban populations are growing at an alarming rate. The need for new supplies of water and large-scale investments in sanitation and waste management put increasing strains on national and local budgets. The rapid rate of development is also bringing to the fore problems associated with toxic waste management, which together with domestic waste management are fast becoming top priorities for environmental planning and policy implementation.

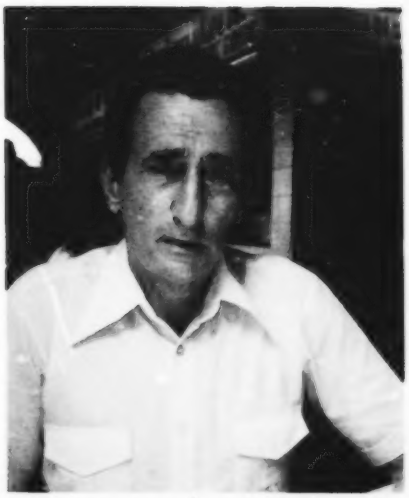
To help cope with these problems, the RWSG will be inviting senior water and sanitation professionals from countries in East Asia and the Pacific to attend four two-week courses in rural water supply, waste management and recycling, as well as toxic waste management and low-cost measures to improve water supply and sanitation management in urban areas. The Ministry of the Environment and the Public Utilities Board will assign engineering specialists as instructors. They will also make their training facilities available to the programme and organize visits to their installations. Course costs will be met by the RWSG regional budget, topped up with extra funding specifically for training from bilateral donors like the Australian aid organization AIDAB, the Swiss Association for Development Cooperation (SDC), GTZ of the Federal Republic of Germany and the Dutch development aid agency.

The topics reflect what Mr. Arlosoroff sees as the most pressing challenges facing the rapidly expanding populations of Asia: the need to tackle environmental problems posed by anarchic waste disposal and to get the most out of limited water resources. "Water demands and resources management are becoming a number one topic," says Mr. Arlosoroff, who estimates that up to 70 per cent of the water supply of the world's cities is wasted through leakage and wasteful practices in domestic and public consumption.

Workshops on waste management will focus on reaping economic benefits from waste by establishing merchants and vendors to link the creators of waste and potential users. For example brokers can sell nightsoil as fertilizer to farmers in rural areas, glass and paper can be sold to recycling plants, and waste incinerators in urban areas can be geared up to produce electricity. The SDC has assigned a senior engineer to this activity.

UNDP photos by Emma Robson

Singapore's restaurants are subject to rigid hygiene controls.



Workers replacing sewage pipes in Singapore's commercial district.
Above: Saul Arlosoroff, manager of the UNDP-World Bank Water and Sanitation Programme for East Asia and the Pacific.

The course on toxic waste management will help managers gear up for the inevitable consequences of expanding industry. It will help to introduce economic approaches designed to head off environmental damage before it gets out of hand.

Participants will be invited to visit Singapore's solid waste recycling plants, which incinerate over 65 per cent of the island's solid wastes and at the same time generate electricity. The professionals will also have a chance to study the measures which make Singapore one of the world's lowest per capita users of water. "Leakage in our water system is something we work hard at to control," says Ong Ho-Sim, Director of Singapore's Water Department at the Public Utilities Board. "Every single tap in Singapore is metered. Users pay according to how much they consume."

The RWSG hopes to use the courses as a springboard for new projects in water, sanitation and waste management, to be carried out in the participants' own countries with technical assistance from the programme and potential support of the World Bank, the Asian Development Bank and other donors. "Other Asian countries can learn a lot from their experience here," says Mr. Arlosoroff. ■

British Aid to Water and Sanitation: The Pursuit of Sustainability

ODA

Lynda Chalker, British Minister for Overseas Development.

The 19th and early 20th Century sewerage and piped water systems of Bombay, Calcutta and Nairobi are legacies of Britain's extensive colonial presence. The fact that most systems are still in service says a lot about Britain's long and solid experience in the water and sanitation field.

In the days of the Empire, it was a case of applying technologies proven effective in Britain's major cities. But Britain's 25-year-old Overseas Development Administration (ODA) has become a prominent advocate of technologies appropriate to developing countries, both in terms of cost and ease of maintenance.

ODA's efforts reflect a strong determination that new facilities provide lasting benefits. Perplexed by a high rate of handpump breakdowns in the late 1970s, ODA contracted Britain's Consumer Association to test pumps purchased by ODA to identify the "best buy." By the early 1980s, the Association's Consumer Research Laboratory had conducted extensive tests on 12 pumps. One of the star performers was a device produced in Malawi, which the Lab helped transform into the Afridev, a representative of a new generation of pumps better suited to village operation and maintenance.

The Lab's pioneering work also triggered a global initiative to improve rural water supply technologies. In 1980, the World Bank, with financing from the United Nations Development Programme, arranged for the Lab to begin testing dozens more pumps from all over the world.

The Administration does not have specific expenditure targets for water supply and sanitation improvements. ODA projects arise in response to requests from the more than 120 countries to which it gives official aid. But in an unusual gesture, ODA made a special allocation of US$5.15 million (now $8.2 million) for water and sanitation activities at the beginning of the "Decade." And nearly 80 per

The Consumer Research Lab: An "African" Village North of London

No account of technological progress during the "Water and Sanitation Decade" would be complete without mention of the pioneering work of the UK's Consumer Research Laboratory. This non-profit, independent agency, which tests products ranging from satellite dishes to microwave ovens for UK consumers, has become a leading institution for the testing and development of handpumps for donor agencies, manufacturers and developing countries.

Since the late 1970s, the Laboratory, 55 kilometres north of London, has played the role of a stern judge in a contest from which only the fittest emerged. The publication through the World Bank of test results has wrought the demise of many designs and helped usher in a new breed of more efficient, simpler and cheaper pumps.

"A lot of the older pumps we tested were pretty awful," recalls Ken Mills, Manager of External Projects at the Laboratory." Pump rod connectors broke, bearings failed, joints leaked, parts corroded and jammed. Many of the pumps were heavy and had too many parts, which were difficult to obtain locally. Strong men and lots of tools were needed for repairs. "Once manufacturers saw the results of their pumps published, there were considerable improvements," says Mr. Mills.

The Lab's diversification into handpump testing began with a request in 1977 to assess designs used by Britain's Overseas Development Administration. In the early 1980s, the testing facilities also provided the Laboratory backup for the UNDP-World Bank field tests in two dozen developing countries. "When we first got into handpumps, we did a world survey and found that no substantial handpump research and testing was being done," says Mr. Mills. "There was a real lack of research into what happened down below, which is where most of the breakdowns were occurring."

When the pumps began rolling into the Laboratory in the late 1970s, its managers were still trying to figure out a way of monitoring what happens to pump parts several metres below ground level. The solution they hit upon was to construct a tower seven metres high, to fix the pump heads on the top floor, and have their underground parts extend down into water tanks on the ground. They developed a special valve designed to create the effect of drawing from depths up to 80 metres.

Technicians then drew up a testing programme designed to simulate in England the kind of rigorous use and abuse a handpump is subject to in rural Sub-Saharan Africa or Asia. Two years of wear and tear, they calculated, could be reproduced through 4,000 hours of non-stop pumping of water mixed with grit, 40 hours of handle-banging, and the use of a weighted bag, posing as an animal, to pummel the pump heads. They also invited men, women and young people to work the pumps and record their impressions.

Pumps are still dispatched to the UK Laboratory, but at a slower rate than at the beginning of the 1980s. In some respects, the Lab has lost business by virtue of sharing its own expertise. It helped China set up its own handpump testing tower and plans to help other countries do the same. Mr. Mills attributes the decline in interest also to a decrease in the number of technical reports published and the high cost of putting a pump through the 12-month testing programme. Mr. Mills is concerned that attention is drifting away from the improvement of pump technologies. "We've got to keep the Decade momentum going on all fronts," he says. "After all, when Henry Ford produced his model T car, he didn't just sit back and relax, did he?" ■

UNDP photo by Emma Robson

Ken Mills explains how his Laboratory has helped improve the reliability of below-ground pump parts.

cent of Britain's bilateral aid goes to countries with a gross national product of less than $700 per capita, such as India and Bangladesh, where water and sanitation improvements rank highly in development priorities. As a result, in 1989, ODA was investing $294 million in 88 ongoing water supply and sanitation projects, out of its annual budget of $2.4 billion.

Many of those projects still relate to technological improvements. With the help of UK research institutes, ODA is promoting innovations in clearing pit latrines and low-cost ways of purifying water. "One of our aims is to produce better, cheaper and more locally manageable tools," says Toby Harrison, Renewable Energy and Engineering Research Advisor to ODA. "We are interested in any process that is more appropriate to local skills," adds Terry Pike, Chief Engineering Adviser to ODA.

In pursuit of sustainable development, ODA has recently taken up a new cause — the participation of women. For the past two years, all ODA managers and professional advisers have been obliged to undergo training courses that aim to ensure that women are considered in the design of all projects.

For historical and cultural reasons, project engineers were not always able or willing to talk to the local women most directly involved in water collection. Engineering tends to be male-dominated, but ODA is ensuring that female managers play a greater role in field activities. "We recognize the need to talk to the customers, not just to someone who says he is speaking on behalf of the customers," says Mr. Pike.

ODA also favours projects which feature the strong participation of the community, including grassroots training in health care, hygiene and maintenance. "We do not see any future in projects which are not prepared in consultation and agreement with communities or local institutions," says Mr. Pike.

Mr. Pike and Mr. Harrison see insufficient attention paid to community and women's participation as a major reason why many new rural facilities are short-lived. "There is still insufficient consultation and coordination with the community," says Mr. Pike.

To remedy that, ODA has increased its contributions to non-governmental organizations (NGOs), which already receive about one-fifth of the total budget. "Working through NGOs is an effective way of sidestepping top-heavy government machinery and encouraging local initiative," says Mr. Pike. "NGOs can often work more effectively than we could," adds Mr. Harrison.

ODA also plans to further strengthen collaboration between its Engineering and Health and Population Divisions on projects it executes itself. "We are still trying to close a gap between engineering and public health," says Mr. Harrison. "We need to increase training both in maintenance and in hygiene education."

In assessing priorities, ODA officials say that the importance of institution-building projects is now recognized. "The problems of long-term operation and maintenance cannot be solved in two or three years," says Mr. Pike. "They require longer-term commitments". ODA has found that an economical way of providing support over an extended period is to assign a team of several experts from a British regional water or sanitation authority to provide advice over a period of ten to 15 years or perhaps even longer. They help the developing country authorities devise five-year plans and set up institutional frameworks, salary structures, financing mechanisms and training schemes for industry professionals. Gradually, the team is reduced in number, but individuals continue to return on short-term consultancies to provide advice where and when needed.

Such a development approach also reflects the sensitivity of a development agency working largely in former colonies to the need to foster self-reliance. "Looking back, we had some difficult transitions to independence," says Mr. Pike. "But we must be doing something right, because ODA people usually get a good reception." ■

UNDP photo by Mary McNeil

Zimbabweans use a wash can modelled after the indigenous makombe gourd to clean their hands after using the latrine.

The Water, Dirt and Diarrhoea Debate

"Dirty water washes clean" is an old Western proverb parents would tell their children at bath time in order to save on heating bills by persuading them to share the tub. Recent research, however, suggests that there is more truth to the expression than previously acknowledged.

Experts have long agreed that diarrhoeal epidemics — the occasional outbreaks of cholera or dysentery which assail entire communities — are often caused by drinking from a common water source contaminated by a virus. Increasingly, however, they are coming to the view that many endemic diarrhoeal diseases — those widely scattered cases of bacterial diarrhoeas which are a leading cause of sickness, malnutrition and death among the developing world's children — are caused by inadequate hygiene rather than drinking contaminated water.

It is yet to be determined just how many diarrhoeal deaths are caused by bacterial agents which can be removed or substantially reduced by washing thoroughly. But current estimates suggest that the diarrhoeal deaths of perhaps more than three million under five-year-olds could be averted each year through better hygiene. "There are many opportunities other than water for disease transmission," says Professor Richard G. Feachem, Dean of the London School of Hygiene and Tropical Medicine. "Think of animals and children excreting in the yard, babies crawling on the ground, putting their hands to their mouths."

The London School of Hygiene and Tropical Medicine has helped advance world understanding of linkages between water, waste and health to new frontiers during this decade. "Up until the 1970s, it was assumed that clean water (for drinking) equalled less diarrhoea," says Professor Feachem. "But during this decade our researchers, together with others, have explored the truth of that assumption and shifted opinion substantially." The School's conclusion is that more water brings greater health benefits than cleaner water. "But both are important," says Professor Feachem.

Dr. Sandy Cairncross, Senior Lecturer in Tropical Public Health Engineering at the School, has just completed a paper, to be published by the World Bank, which supports this conclusion by drawing on several recent case studies. "It is difficult to tease out the two impacts (of water quality and domestic hygiene)," says Dr. Cairncross, "but the most important factor appears to be changes in people's hygiene."

The World Health Organization (WHO) recommends that each person be provided with 25 litres of water for daily domestic use. For washing, ideally soap should also be used. Existing evidence, which some experts term inconclusive, suggests that soap substantially reduces the presence of bacterial diseases. "Washing with soap may be the most cost-effective diarrhoeal control method that there is," says Dr. Cairncross, who is currently investigating reasons why its use is not more widespread in developing countries. Doctor Michael Merson, Director of the WHO Diarrhoeal Diseases Control Programme, is not quite convinced: "Soap helps to remove the organisms, although water alone

Proven Ways of Preventing Diarrhoea

Good Nutrition:	Exclusive breast-feeding for the first 4-6 months of life and continued breast-feeding for the first two years. Proper weaning.
Use of Safe Water:	Collecting ample water from the safest source. Protecting water from contamination.
Good Hygiene:	Hygienic excreta disposal, including use of latrines and care in disposing of babies' stools, which tend to be more infected than those of older children and adults. Washing hands with soap.
Vaccination:	Measles vaccination helps prevent measles-associated diarrhoea. Vaccines against Rotavirus, the cause of ten to 20 per cent of diarrhoeal deaths, are showing promising results in current field tests.

seems pretty effective too."

Researchers at the Blair Research Laboratory in Harare, Zimbabwe, have long been convinced of the effectiveness of washing as a means of reducing germs related to diarrhoea. They have spent the past several years devising methods of persuading people to wash frequently. One idea was to manufacture small tin wash basins, modelled after the familiar, indigenous macombe gourd, and get families to hang them outside their latrines as a reminder to rinse their hands from them.

In terms of keeping oneself clean, quantity appears to be more important than water purity. "Data from recent studies corroborate that as far as morbidity (illness) is concerned, water volume is more important than quality," says José Martines, a specialist in epidemiology and diarrhoea prevention with the WHO Diarrhoeal Diseases Control Programme. But Dr. Martines notes there is lingering concern over the quality of water for the preparation of food, especially of vegetables to be eaten raw. "If you look at the total rate of diarrhoea, water quality is likely to be a minor factor," he says. "But a consensus has not been completely reached."

The outcome of the current debate is crucial, for it will determine the focus of activities and direction of investments. Is money better spent on providing a biologically pure supply from taps and storage tanks? Or should efforts focus more on reducing the health hazards posed by the presence of human and animal waste, impressing upon individuals the importance of using latrines hygienically, and keeping their homes, yards and their persons clean?

— **Emma Robson.**

Crisis on Tap:

Continued from page 2.

systems of water law and allocation establish clear property rights, and has been used in various countries for hundreds of years.

By helping establish a scarcity price, markets push water toward higher valued use. Farmers in Israel, the Texan High Plains and the Soviet Ukraine have shown that water use can be reduced 20 to 30 per cent in a matter of years by adopting modern technologies and management practices. Upgrading sprinklers, recycling used irrigation water, installing water-thrifty drip systems and irrigating only when crops really need it are just a few of the ways farmers can save. Moreover, since agriculture consumes such a disproportionately large share of water in most water-short areas, freeing even a small part can cover enormous growth in urban drinking water demands.

Yet economic incentives and efficiency alone cannot avert shortages. Any hope for balancing Egypt's needs with supplies, for example, rests as much on the nation's ability to slow birthrates as it does on modernizing irrigation systems. And in degraded areas such as the Himalayas, reforestation efforts may be needed to restore critical watersheds. Averting outright water wars in the Middle East will require that Israel, Jordan, Syria and other neighbouring nations begin co-operating to find mutually acceptable solutions to their shared predicament.

Societies can muddle through with another dam here and a well there — but only for so long. Ignoring water's natural limits will only make the consequences of overstepping them hit home sooner and harder. ■

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This comprehensive handbook compares the merits of water-pumping windmills with solar, engine-driven, animal-traction pumps and handpumps. The characteristics of various windpump designs are described, and guidelines are given for comparing the economic benefits of the pumps with other pump technologies. The report contains a separate annex on testing and monitoring wind pump systems in field conditions.

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Siri Melchior, who heads UNDP's PROWWESS project (Promotion of Women in Water and Environmental Sanitation Services), presents her personal views on the importance of women's participation in the development process. Drawing on her 19 years in the health and development field, Ms. Melchior summarizes her experiences and presents examples of the kinds of projects that work and fail. The aim of the paper is to provoke responses from other actors in the development forum. Interspersed with enlightening anecdotes and quotes from other development experts, this latest issue in the PROWWESS Lessons-Strategies-Tools series makes interesting reading for all those who, like PROWWESS, are striving for more, better, bigger, cheaper and lasting water and sanitation facilities. So where do the tomatoes come in? Read it!

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The Water of Ayole shows how a poor village in the West African nation of Togo is making its new water system work. Directed and produced by award-winning filmmaker Sandra Nichols, it is available in English and French as a 28-minute video tape (VHS-NTSC or PAL).

The Fiery Serpent provides vivid lessons from Nigeria about the prevention and control of the dreaded Guinea worm disease, which afflicts 20 million people worldwide, mainly in Africa. Available in English and French as a 20-minute video tape (VHS-NTSC or PAL).

Photo: Sandra Nichols

Courtesy of Source, UNDP